LUCAS AEROSPACE COMBINE SHOP STEWARD COMMITTEE

CORPORATE PLAN

A contingency strategy as a positive alternative to recession and redundancies.

This is merely an introduction to the Corporate Plan and a summary of its proposals.

The total plan includes 5 detailed technical sections each of approximately 200 pages.

These sections may be viewed upon request to the secretary:

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INTRODUCTION

This Corporate Plan was prepared by the Lucas Aerospace Combine Shop Stewards Committee for that section of Joseph Lucas Industries which is known as Lucas Aerospace.

If a brief description of Lucas Industries is provided this gives an economic, technical and company background against which the performance and potential of its wholly owned subsidiary, Lucas Aerospace, can be viewed. It was also felt desirable to do so as some of the alternative products proposed elsewhere in this report, although emanating from aerospace technology, could more appropriately be handled, at the manufacturing stage, by production techniques and facilities available elsewhere in the Lucas organisations.

Lucas Industries Ltd.

Lucas Industries is a vast and complex organisation with design, development, manufacturing, sales and services activities in the automotive, aerospace and industrial sectors of the economy.

The Company which was formed in 1877 now has some 80 000 employees and an annual turnover of approximately £300 000 000 and capital investment of £110 000 000. A simplified schematic diagram of the U.K. structure is provided in Appendix 1.

A discernable feature of the Company's mode of operation during the past few years has been to shift large quantities of capital, resources and technological know how into overseas activities. The scale and nature of this may be judged from Appendix 2. This raises a whole host of fundamental, political, economic and industrial questions, as is the case with the operation of any Multi-National Corporation. It is not the purpose of the Corporate Plan to analyse these. Suffice to say that this tendency is causing deep rooted concern amongst large sections of Lucas employees and they will clearly have to consider appropriate means of defending themselves from the likely repercussions of these developments. These views and anxieties are reflected in the Aerospace division .

Lucas Industries hold a monopoly, or near monopoly position, in respect of a number of product ranges both in the United Kingdom and in Europe. However the present economic crisis, itself a reflection of the inherent contradictions of the market economy, is having serious repercussions within Lucas Industries. At the time of preparing this report the Company is

attempting to shed large sections of labour in some of its plants There has also been a serious cut in the living standards of all Lucas workers both by hand and brain since 1972. The attitude of the Company to its employees and society at large is however no worse that that of its international competitors and it is certainly better than some of them. However, a sophisticated industrial relations set up and a relatively elaborate network of consultative devices simply provide a thin veneer of concern, beneath which is concealed all the inevitable ruthlessness of a large corporation involved in the frantic international competition of the 1970's.

Lucas Aerospace Ltd.

Lucas has been in the aircraft equipment field since 1926 when it acquired a subsidiary Rotax. Prior to World War II Lucas set up a parallel aircraft equipment company known as Lucas Gas Turbine Ltd. This was formed initially to design, develop and manufacture the fuel system and combustion chamber for the Whittle gas turbine engine. Through this Company close collaboration was established with Rolls Royce and that continues to this day. Thus, since the end of the War and up to the late 60's Lucas had, in practice, two distinct aircraft component operations. Rotax, which supplied electrical generating systems, starting systems and small gas turbine driven auxiliary power units, whilst Lucas Gas Turbine Equipment supplied engine fuel systems and larger fabricated components.

During the 60's Lucas had three major competitors in the electrical aircraft field namely, Plessey, English Electric and A.E.I. Lucas Gas Turbine Equipment division did not have a competitor and Lucas, at that stage, was not engaged in the design of flying control and actuating systems. Paradoxically the turmoil in the U.K. aircraft industry of 1965, when the Labour Government cut back a number of major products, provided the objective circumstances in which Lucas could establish itself as the dominant force in these fields.

In 1968, through Rotax, it took over the A.E.I. interests at Coventry and then the Special Products Division of English Electric at Luton, Bradford and Netherton in 1969. Lucas further extended its influence in the aircraft equipment field by moving into the flying control and actuation systems side by acquiring Hobsons of Wolverhampton in 1969. The resultant structure of the new organisation now known as Lucas Aerospace is depicted in Appendix 3.

The 'Internationalisation' of Lucas Aerospace followed closely the pattern of Lucas Industries described above. Through its acquisition of English Electric it acquired a 40% stake in Auxilec of France and 34% stake in P.L.U. of Germany - a joint company set with Bosch (15%) and Pierburg (51%) to produce hydro-mechanical fuel systems particularly for the M.R.C.A. This pattern has continued to provide an international organisation depicted in Appendix 4. The result is a Lucas Company achieving the same dominance in the field of aircraft components

as other sections of Lucas have achieved in the automotive industry. Lucas Aerospace is now the only Company in the World with the capability of producing, within a single organisation, a complete range of aircraft electrical generating systems and switchgear, engine starting, de-icing, flying control, fuel management, thrust reverse and combustion systems, instrument lighting and cockpit transparencies (1)

Lucas Aerospace also produce a range of equipment for defence applications on both land and sea. The current major committments include extensive systems work on the RB.211, Concorde, the TU144 supersonic airliner, the Lockheed Tri-star, the A300B Airbus, the European Multi Role Combat Aircraft (MRCA) and the Anglo French Jaguar. The full scale of Lucas Aerospace current activity is shown in Appendix 5. A measure of the diverse range of products which the Company is capable of designing, developing and manufacturing is provided in Appendix 6.

Approximately 20% of Lucas Industries resources are now devoted to the Aerospace industry. Lucas Aerospace now has just over 13 000 employees. This is a highly skilled and talented workforce, comprising a very wide spectrum of technological ability both in the manual and intellectual field. With a high design and development content it is inevitable that there is a large proportion of technical staff and there are 2 200 engineers, designers and draughtsmen of various kinds. Aerospace deploys some 5 000 machine tools and approximately 250 of these are advanced machine tools which are numerically, automatically or digital display controlled. This is supported by extensive research and development facilities and laboratories, Appendix 7.

In consequence of this, Lucas Aerospace is now Europe's largest designer and manufacturer of aircraft systems and equipment.

The Combine Committee

The five years from 1964 to 1969 saw a very rapid monopolisation of large sections of British Industry and the emergence of massive Corporations such as British Leyland and G.E.C. This process was actively supported by the government, which, in many instances, was providing the tax payers money to lubricate the process. Within Mr. Wilson's philosophical framework of 'the white heat of technological change' many thousands of highly skilled workers found that the consequence of the 'White Heat' market economy was that it simply burned up their jobs and gave rise to large scale structural unemployment. . The 'logic' of the market economies and rationalisation programmes in these vast Corporations resulted in the illogical growth of the dole queue with all the degredation and suffering and loss of economic activity of hundreds of thousands of highly skilled men and women.

The Weinstock empire, that is G.E.C., was the pacemaker in this development. The work force was reduced from 260 000 to 200 000 whilst during the same period the profits went up from £75 000 000 to £108 000 000 per annum. Thus whilst it was profitable for Weinstock to cut his work force, society at large had to pay the price, firstly in social security payments for those involved and secondly in the loss of productive capacity which these people could have made to the economy of the nation as a whole. Weinstock's attitude to the work force, summed up by one of his managers in a statement to the Sunday Times ' he takes people and squeezes them until the pips squeak' was seen as some kind of virtue. Indeed it is a measure of the deep rooted economic and political sickness of our society that a person like Weinstock was then, and is still, held up as the pinnacle of managerial competence.

When Lucas acquired parts of English Electric in the process described above, the lessons of the Weinstock escapade were not lost on Lucas workers. It was clear that Lucas Aerospace, if it were permitted, would embark on a similar rationalisation programme . Strangely enough it was recognition that this attack would be made upon the work force that provided the objective circumstances in which the Combine Committee was formed.

Its formation resulted in the first instance from fear of redundancy, and the recognition of the need to provide an organisation which could fight and protect the right to work. It was realised from the onset that the Combine Committee could itself become another bureaucracy and that there were real dangers in centralising activities of all factories through one body. Accordingly a constitution was carefully worked out and widely discussed at all sites which protected against this, see Appendix 8.

Development of the Combine Committe, now known as the Lucas Aerospace and Defence Systems Combine Shop Stewards Committee, took approximately $4\frac{1}{2}$ years. In its early stages it lacked cohesion and strength. The Company was, as a result of this, able to embark on a rationalisation programme in which the work force was reduced from 18 000 to the present 13 000. However at the last attempted sacking of 800 workers in January/February '74 the Combine Committee was well enough organised to resist this. The Combine however has no illusions that the right to work can ever be guaranteed in a market economy.

Gradually the Combine Committee set up a series of advisory services for its members. These include a pensions advisory service which has recently negotiated a complex pension structure for manual workers (2) and the campaign for the election of trustees for the staff pension fund in order that information could be available as to where this pension fund money is being invested. The importance of this development may be judged by the fact that the staff pension fund has a market value of something like £80 000 000 and the works one £40 000 000 at a time when the capitalisation value of Lucas as a whole on the stock market has been as low as £36 000 000.

Other services included a Science and Technology Advisory Service which provided technical information on the safeguards to be campaigned for when new equipment was being introduced (3) or when health hazards were possibly involved (4).

The Combine Committee is also a reflection of the growing awareness, of those who work at the point of production, that the traditional trade union structures based on geographical divisions and organised on a craft basis are incapable of coping with the new and complex problems of these large monopolies. However the Combine Committee should not be seen as an alternative to the traditional trade union movement rather it is a logical development from it, and complementary to its aims.

The Combine Committee produces its own four page illustrated newspaper approximately bi-monthly, 10 000 copies of this are circulated amongst the 13 000 manual and staff workers.

In practice the Combine Committee has become the voice on a number of subjects for the 13 000 manual and staff workers who now work throughout Lucas Aerospace in the United Kingdom. It has also taken a series of steps to establish close links with those employed by Lucas Aerospace abroad. The significance of its development has been included in lectures at the T.U.C.(5) on the training courses for shop stewards and for full time T.U. education officers.

Corporate Plan

The object of the Corporate Plan is twofold. Firstly to protect our members right to work by proposing a range of alternative products on which they could become engaged in the event of further cut backs in the aerospace industry. Secondly to ensure that among the alternative products proposed are a number which would be socially useful to the community at large.

The idea of proposing alternative products on which the work force could be engaged as an alternative to the redundancy arising from cut backs in the aerospace industry is not new in Lucas Aerospace; as far back as 1970 when the Company was attempting to close the Willesden site a number of projects were put forward at the negotiations which took place on that occasion. However the idea of preparing an overall Corporate Plan for Lucas Aerospace arose in the first instance at a meeting in November 1974 with Tony Benn, the then Minister of Industry. That meeting took place at the request of the Combine Committee to discuss the nationalisation of Lucas Aerospace. In the course of the meeting Mr. Benn suggested that there was the distinct possibility of further cut backs in certain aerospace and military projects.

Even if this did not occur the rate at which new projects would be started was likely to be reduced. Accordingly he felt that the Combine Committee would be well advised to consider alternative products, not excluding intermediate technology on which our members could become engaged in the event of a recession.

The problems of the aerospace industry have of course been further compounded by the 'energy crisis'.

It is also likely that in order to make its austerity measures somewhat acceptable, the government will at least make a gesture towards cuts in defence expenditure . As the Defence Secretary, Mr. Roy Mason, stated in the House of Commons recently 'even before the Defence Review it was clear that with few new projects coming along there would be a marked reduction over the next decade in the level of activity in military aerospace projects, particularly on the design side' (6)

These reductions we regard as both inevitable and desirable. Indeed it is the national policy of almost all of the unions the Combine Committee represents that there should be cuts in defence expenditure. However when these cuts are made our members are placed in the position of being made redundant or fighting for their continuation. We ourselves have done this in the past and will support our colleagues in the rest of the aerospace industry in doing so in future. Indeed, recently when the campaign to protect the H.S.146 was at its height our members at the Wolverhampton plant seized drawings in support of their colleagues at Hawker Siddeley's.

It has to be recognised however that the traditional method of fighting for the right to work has not been particularly successful. Between 1960 and 1975 the total number in the aerospace industry has been reduced from 283 000 to 195 000 workers. Apart from this internal problem in the aerospace industry there is the more general problem in which all industries are tending to become capital intensive rather than labour intensive with structural unemployment in consequence.

Over the past 8 or 9 years there has been some 5 000 000 people permanently unemployed in the United States. The same sort of structural difficulties are now manifesting themselves even in West Germany where there are 1 000 000 people out of work and some 700 000 on short time working. These structural problems are likely to be further compounded by the rationalisation of the European Aerospace Industry within the Common Market. Finally it is to be anticipated that Lucas Aerospace will attempt a rationalisation programme with its associated companies in Europe.

It is not suggested in this report that Lucas Aerospace is suddenly going to cease to be deeply involved in the aerospace industry. We recognise, whether we like it or not, that the aerospace industry is going to remain a major part of the economic and technological activity of the so called ' technologically advanced nations'.

The intention is rather to suggest that alternative products should be introduced in a phased manner such that the tendency of the industry to contract would firstly be halted and then gradually reversed as Lucas Aerospace diversified into these new fields.

It is also evident to us that when the three sectors of the aerospace industry are nationalised the relationship between them and Lucas Aerospace may well change. We have clear indications from our fellow trade unionists in those bodies that they will not be prepared to see the lucrative parts of the industry hived off by the component manufacturers; in this we fully understand their motives and support them.

As trade unionists we do not wish to see a relationship between the aerospace component firms and the nationalised sector of the industry which would be similar to the relationship of the equipment manufacturers to the National Coal Board. Such a relationship would provide the opportunity for those forces in society hostile to nationalisation to point out that nationalised industries were economically unsuccessful, whilst in practice they would cream off the research and development which was paid for by the tax payer into component companies. It has already been stated to us therefore, that our colleagues in the nationalised sectors of the aerospace industry will be demanding that these industries diversify such that any potential contraction is at least in part countered by those industries engaging in the manufacture of some of the components which they now buy from outside.

The desire to work on socially useful products is one which is now widespread through large sectors of industry. The aerospace industry is a particularly glaring example of the gap which exists between that which technology could provide, and that which it actually does provide to meet the wide range of human problems we see about us. There is something seriously wrong about a society which can produce a level of technology to design and build Concorde but cannot provide enough simple urban heating systems to protect the old age pensioners who are dying each winter of hypothermia (it is estimated that 980 died of hypothermia in London alone last winter, which was a particularly mild one).

Further it is clear that there is now deep rooted cynicism amongst wide sections of the public about the idea, carefully nurtured by the media, that advanced science and technology will solve all our material problems.

As Professor Jung recently said to an international trade union gathering "the deterioration in the quality of life is already noticeable in the highly industrialised areas of the world, and this, presumably still accelerating trend, makes it increasingly difficult for scientific and technological thought and planning to enjoy the blind trust it received in the past decades" (7)

Of particular significance in this connection is the much publicised rejection by capable sixth formers of the places that are available for science and technology at British Universities. Science and technology is perceived by them to be de-humanised and even brutal and the source of a whole range of problems, not only for those who work in the industries themselves but also for society at large.

It is our view that these problems arise, not because of the behaviour of scientists and technologists in isolation, but because of the manner in which society misuses this skill and ability. We believe however, that scientiests, engineers and the workers in those industries have a profound responsibility to challenge the underlying assumptions of large scale industry; seek to assert their right to use their skill and ability in the interest of the community at large. In saying that, we recognise that this is a fundamental challenge to many of the economic and idealogical assumptions of our society.

It is certainly not the assumption of this Corporate Plan that Lucas Aerospace can be transformed into a trail blazer to transform this situation in isolation . There can be no islands of responsibility and concern in the sea of irresponsibility and depravity. Our intentions are much more modest, namely to make a humble start to question these assumptions and to make a small contribution to demonstrating that workers are prepared to press for the right to work on products which actually help to solve human problems rather than create them.

It remains our view that no matter how many sections of workers in other industries take up these demands the progress can only be minimal so long as our society is based on the assumption that profits come first and people come last.

Thus the question is a political one, whether we like it or not. Perhaps the most significant feature of the Corporate Plan is that trade unionists are attempting to transcend the narrow economism which has characterised trade union activity in the past and extend our demands to the extent of questioning the products on which we work and the way in which we work upon them. This questioning of basic assumptions about what should be produced and how it should be produced is one that is likely to grow in momentum.

In July 1970 the United Automobile Workers of America (U.A.W.) issued a statement to General Motors Corporation asserting that U.A.W. members had a direct legitimate concern in pollution caused by the automobile industry and claiming the right to raise the issue in collective bargaining. The union asked to know about future programmes of General Motors ' designed to eliminate pollution, both from within the plants and outside the plants caused by waste emitted by the Corporation's factories and by internal combustion engines'.

In September 1972 Douglas Fraser, the head of U.A.W. Chrysler Dept., announced that the union had asked Chrysler Corporation to begin talks on how to 'humanise' jobs on the assembly line. He said that if the Corporation refused the request, the issue of workers boredom and dissatisfaction would be one of the unions most important bargaining goals (8)

Activities of this kind will, in our view, be far more significant in the long term than campaigns for worker participation or workers directors. This Combine Committee is opposed to such concepts and is not prepared to share in the management of means of production and the production of products which they find abhorrent. Indeed at times of Company crisis the real role of the so called directors becomes self evident. Thus in spite of one third of the seats on the Volkswagen board being filled by union representatives and these voting with socialist politicians on the board, which in practice is said to give a 50 - 50 say in the running of the plant, this in no way helped the workers during the massive redundancies which took place in Volkswagen recently (9)

There cannot be 'industrial democracy' until there is a real shift in power to the workers themselves.

Trade Unionists at the point of production through their contact with the real world of manufacturing and making things are conscious of the great economic power which workers have. This growing sense of confidence by working people to cope with the technological and social problems we see about us is in glaring contrast to the confusion and disarray of management, particularly in the highest echelons of industry.

Corporate Social Responsibility

It is clear that even amongst the supporters of private industry there is a growing recognition that things will have to change. Issues such as the 'quality of life' and the harnessing of the productive forces to meet human needs are likely to be issues of major political importance during the coming years. Even those whose policies have given rise to the present economic and social crisis now admit that change is inevitable. 50% of the key policy makers in Europe agreed 'the 1970's will see an economic crisis provoking a re-examination of economic aims, the pursuit of growth will give way to a search for 'quality of life' for social justice and solidarity (11) .

The motives of the "large scale corporations are quite correctly perceived to be anti social". The growth of large scale corporate industries during the past century appears to furnish additional evidence of business men's anti-social behaviour, first in the trust problem and the treatment of labour and more recently in racial discrimination, pollution of the environment, contribution towards low levels of public taste, inability to achieve stability in the economy and inadequate consumer service and protection. The rosta of accusations viewed over the past decade seems to be lengthening and the intensity of antagonism appears to be rising ' (12)

The rosta could indeed be lengthened to include the de-humanised forms of work in the plants of these corporations and even the interesting contradiction for them that they are unable to provide the right to work for our members in order that they can exploit them! All of this, it seems to us, arises because the motive force behind industries of this kind is the maximisation of profit.

In order to retain some kind of public creditability the large corporations are even denying that profit is now the main motive. The manager of the French subsidiary of the American Corporation Singer is quoted as saying "profit remains vital to our survival but it cannot any longer be our sole aim. Human related goals must be advanced, the satisfaction of wage earners and consumers and the protection and upgrading of the environment" (13)

Peter Parker, Chairman of Rockware Group, told a conference of the British Institute of Management "the social dimension is for me the most demanding and decisive of the decade. Its scope includes relationships with government and institutions, organisational adjustments to the ages, social priorities of classlessness and of establishing consent to the exercise of industrial power, of a decent environment and of personal and moral attitudes towards the question of efficiency to what purpose and at what price".

He went on to state "with social responsibility we are dealing with an idea whose moment has come at last' (14)

Social responsibility has been defined as 'the committment of a business or business in general to an active role in the solution of broad social problems such as racial discrimination, pollution, transport or urban decay" (15) Some Companies are even putting forward social responsibility audit check lists, see Appendix 9.

It remains our view that businesses will look at social responsibility purely in terms of profits, indeed as Maguire has pointed out, social auditing represents "a crude blend of long term profit making and ultrauism" (16)

We believe this Corporate Plan will provide an opportunity for Lucas Aerospace to demonstrate whether it is really prepared to take its social responsibility seriously or not.

JOB REDESIGN

The past seventy years have seen systematic efforts to de-skill jobs, to fragment them into small narrow functions and to have them carried out at an increased tempo. This process which oddly is known as 'Scientific Management', attempts to reduce the worker to a blind unthinking appendage to the machine or process in which he or she is working.

In Scientific Management as its founder, Fredrick Winslow Taylor tells us "the workmen is told minutely just what he is to do and how he is to do it and any improvement he makes upon the orders given to him is fatal to success"(17) Taylor was not unaware of the implications of what he was doing and once said "that the requirements of a man for a manual job is that he shall be so stupid and so phlegmatic that he more nearly resembles in his mental make up the ox than any other type" (18)

The tendency to destroy skill and job interest is now evident in all fields of manufacturing including in Lucas Aerospace; but human beings are not oxen and are rebelling against such a system in many ways. In Volvo in Sweden, the labour turnover in 1969 was 52% and absentee rate reached 30% in some plants. In the United States the reaction has been even more dramatic; in General Motors Lordstown's plant the computor controlled production line and the products on it have been directly sabotaged by workers who felt completely oppressed by their working environment (20)

This is of course inevitable in a society which views workers merely as units of production and tries to treat them accordingly. Moral arguments will certainly not change the situation, in fact Griener - a leading academic in this field - suggests that successful change does not begin until strong environmental and internal pressures "shake the power structure at its very foundation until the ground under the top managers begins toshift it seems unlikely that they will be sufficiently aroused to feel the need for change, both in themselves and in the rest of the organisation "(21)

Nor are these problems confined to the shop floor. The past ten years have seen the extension of various forms of 'Taylorism' into the fields of white collar and mental work (22)

Behavioural scientists and others are now making vast fortunes advising management of job enrichment schemes and group technology. These of course are simply devised to get more out of each worker. In fact workers have always known that is far better if people work in teams and know what each other are doing. They know that if they are engaged on work which is challenging to them this results in better products of higher quality.

However modern industry continues to move in the opposite direction a gradual replacement of human beings by machines, a change in the organic composition of capital in which industry is made capital intensive rather than labour intensive. Not only does this give rise to serious problems of structural unemployment but it also causes serious problems as far as quality of products is concerned, and more importantly 'quality of life'.

It is clearly evident from some of the Lucas Aerospace plants that attempts to replace human intelligence by machine intelligence (e.g. over emphasising the importance of numerical controlled machine tools as against human skill) have had quite disasterous results. It is intended to campaign for quite radical job re-design which will protect our members from this.

The idea of a Corporate Plan of this kind is an entirely new initiative by industrial workers. It is, to our knowledge, the first time that such a plan has been proposed in the United Kingdom. There has, of course, been some developments of this kind abroad, notably in Italy where at Fiat the work force put forward a series of social demands in addition to the straight forward economic ones (such as wages).

Whilst the Combine Committee is unanimous in its desire to have the Corporate Plan produced, there is by no means universal agreement on the tactics for its introduction. This is because of the industrial dangers which arise in a project of this kind. There is obviously the danger that the discussions with the Management about the implementation of the plan, (if it were agreed that such discussion should take place,) could gradually degenerate into a form of collaboration. There is also the danger that, even if collaboration were carefully avoided, the Company might simply take parts of the Corporate Plan and have all this technology on the free. The plan has taken a very considerable length of time to prepare and involved many evenings and weekends of work. It has also meant that outside experts have been prepared to give generously of their detailed knowledge in order to help the development of the Corporate Plan.

In these circumstances the greatest care will have to be taken to ensure that the Company does not succeed in drawing off the 'money spinners' from the plan, and perhaps even having these produced abroad, whilst declining those products which would be socially useful. It is even conceivable that whilst the Company would take sections of the plan, our members may still be confronted with the perennial problem of redundancy. Because of these dangers it is suggested that the correct tactic would be to present only part of the plan to the Company, and then to test out in practice the manner in which the Company will attempt to deal with it.

Approximately 150 products were proposed for the Corporate Plan. 12 of these were selected for presentation at this stage and are suitable for use in the following 6 major areas of technological activity.

1. Oceanics.
2. Telechiric Machines.
3. Transport Systems.
4. Braking Systems.
5. Alternative energy sources.
6. Medical Equipment.

Each of these major areas is supported by a file of some 250 pages of detailed technical and economic supporting information. Only that on alternative energy sources is provided at this stage. A summary of the products chosen is included at the end of this section of the Corporate Plan.

While the Corporate Plan was being prepared, unemployment problems arose at the Hemel Hempstead and Marston Green plants. Separate mini corporate reports were prepared for these plants and they are being handled by the local shop stewards committees.

EMPLOYEE DEVELOPMENT PROGRAMME

The prosperity of Britain as a manufacturing nation depends to a very large extent upon the skill and ability of its people and the opportunity to use that skill and ability to produce commodities.

During the past five years the Lucas Aerospace work force has been reduced approximately 25%. This has come about either by direct sackings or by a deliberate policy of so called natural wastage, i.e. not replacing those who leave, or encouraging early retirement. The net result has been that highly skilled teams of manual workers and design staff have been seriously diminished and disrupted; we cannot accept that such a development is in the long term national interest.

Coupled with this development has been one inside the Company in which attempts have been made to replace human intelligence by machine intelligence, in particular the introduction of numerically controlled machine tools. This has, in a number of cases, proved to have been quite disasterous and the quality of the products have suffered in consequence.

In many instances the Company has fallen victim of the high pressure salesmanship of those who would have us believe that all our problems can be solved by high capital equipment. We have allowed our regard for human talents to be bludgeoned into silence by the mystique of advanced equipment and technology, and so forget that our most precious asset is the creative and productive power of our people.

When we reviewed the work force we now have, our concern centres on four points. Firstly, very little is being done to extend and develop the very considerable skills and ability still to be found within the work force. Secondly the age group in some of the factories is very high, typically around 46 - 50 years average. Thirdly there is little indication that the Company is embarking on any real programme of apprenticeships and the intake of young people. (It is in fact sacking apprentices as they finish their time). Fourthly the Company is making no attempt to employ women in technical jobs and apart from recruitment of these from outside, there are many women doing routine jobs well below their existing capabilities. Quite apart from the desirability of countering these discriminatory practices, the employment of women in the male dominated areas would have an important 'humanising' affect on science and technology.

In that section of the report dealing with specific recommendations we propose a number of steps which should be taken in this direction. The section of this report is concerned with development and retraining facilities for the existing workforce this we regard as important at two levels, firstly retraining and re-education would mean that we were developing the capabilities of our people to meet the technological and sociological challenges which will come during the next few years. Secondly, in the event of work shortage occurring before alternative products have been introduced the potential redundancy could be transformed into a positive breathing space during which re-education could act as a form of enlightened work sharing.

During the past 10 years a number of social, political and economic factors have become clearly discernible which suggests that the traditional pattern of education/work/retirement will grow increasingly inappropriate in the fourth quarter of the 20th century. For the purpose of the Corporate Plan the most important of these factors are:

1. The exponential nature of technological change (Ref. 23 and 24)

2. The rate of knowledge obsolescence and break up of skills associated with 1 above. (Ref. 25).

3. Structural changes in manpower requirements (Ref. 26 and 27)

4. The movement towards equal employment and education apportunities for women (Ref. 28).

5. The political and social unacceptability of structural unemployment as a feature of advanced industrial society. (Ref. 29 and 30)

There are some indications that the trade union movement, educational institutes, and even some Managements are beginning to respond to this new situation. The growing interest in adult and recurrent education and retraining is an indication of this (Ref. 31). It is also encouraging to see international bodies, such as the O.E.C.D.'s Centre of Educational Research and Innovation, proposed recurrent education which permits 'educational apportunities to spead out over the individuals life time' (ref. 32).

Some countries have already well established and co-ordinated retraining and educational programmes. In Sweden for example, apart from all training within industry, and the individuals own initiate, the state recognises an annual training need of 1% of the total work force (Ref. 33). Even in the United States, where the short sightedness of private enterprise is at its worst, some large corporations now include training and education as part of the corporate social responsibility activities (Ref. 34).

In general, however, the tendency is to discard older employees and engage younger ones 'with new knowledge'. This, unfortunately, is likely to remain the predominant business attitude for some time to come. It is an attitude which we cannot and will not accept. In our view there is a need for a blending of the dynamism and drive of the young people, to be counterbalanced by the experience and knowledge of older workers, who should also have the opportunity of having their knowledge updated.

More attention is now being given to the importance of 'human assets', although the terminology used reveals the real motives of many of the companies, for example reference is made to 'human capital' (Reference 35, 36, 37). However there are some indications that the value of re-training employees 'who know the company system' is beginning to be recognised. The growing pressure from the international trade union movement for retraining and re-education of older workers (which can frequently mean a little over 40 in some fields) is likely to be a significant factor during the next decade (Ref. 38, 39 & 40).

It is to be anticipated that these international tendencies will be reflected in the United Kingdom, although to date the emphasis has been on compensation and unemployment payments rather than re-education as an occupational form of 'work-sharing'.

Unemployment is a social evil which need not occur in advanced industrial society and should not be tolerated. It represents a tragic wastage of the nations greatest asset, its people's creative and productive power. Whilst it may seem feasible from an accountant's viewpoint to balance his book by sacking a few hundred workers the loss to the nation as a whole can be very considerable. This loss arises firstly because the individuals involved are denied the right to produce, hence the commodities that they would have

created are no longer available. Secondly the state is involved in vast sums of money which are paid as earnings related unemployment benefit and in compensation to the individuals who lost their jobs.

For the individuals involved there is the indignity and degradation of the dole queue; for the tax payer there is the expenditure on these social services. It is our view, therefore, that even in a narrow economic sense it would be feasible to propose that part of the money that would have been available had these people been redundant, should be provided as a basis for part time education, thereby protecting the individual from the dole queue whilst at the same time investing in the nation's future manpower.

The employment protection bill may provide an employee with a guaranteed payment from his employer if he is not given work on a normal working day, this can be to a maximum of £30 a quarter and is calculated to cost industry £80 000 000 per annum (Ref. 41).

Mr. Albert Booth, Secretary of State in the Department of Employment, recently pointed out that the government is considering paying up to £10 a week for each employee in cases of potential redundancy involving over a hundred workers as a means of countering unemployment. In these circumstances, it seems that it would be economically feasible to suggest training, particularly if backed by a government grant, through an engineering/ industrial training board, as one means of countering short term conditional unemployment. In fact the T.U.C. in its annual economic report suggested that £50 000 000 should be made available to the manpower services commission, including £20 000 000 for a job creation programme (Ref. 42) We do not believe that private enterprise should be allowed to shift its responsibilities in this respect onto the state. We do however feel that the state should face up to its responsibilities by making some funds available for alternative projects in industries where redundancies would have otherwise occurred.

It should be emphasised that we are not, in this context, talking about retraining for white collar and technical staff only. It is our view that the entire work force including semi-skilled and skilled workers are capable of retraining for jobs which would greatly extend the range of work they could undertake. This would provide apportunities which they may have been denied, for a number of reasons, at an earlier stage in their lives.

Such courses could best be organised in local technical colleges and polytechnics. It is our view that universities are too rigid in both their entrance requirements and teaching methods. The courses would have to take into account that many of those involved would not have had traditional forms of education and paper qualifications, but could bring to the course a wealth of experience through actual work in industry.

It would further mean that those teaching on these courses would have to develop new teaching methods and have a real respect for people who had industrial experience. Such an arrangement would not be without its advantages for the polytechnic and technical colleges involved, as such trainees could bring to these institutions a much more mature and balanced view about productive processes in general, but also about wider political, social and economic matters.

OCEANICS - A BRIEF REVIEW

The ocean beds cover over 70% of the earth's surface. It is clear that during the coming years there will be an ever increasing use made of this vast area. Judging by the irresponsible manner in which human beings have used the first 30% of the earth's surface the prospect is one which we view with considerable trepidation.

The exploitation of the ocean bed is likely to take at least three forms;

1. Exploration & extraction of oil and natural gas.
2. Collection of mineral bearing nodules.
3. Submarine agriculture.

Oil

It has been estimated that 15% of the worlds oil is already drawn from coastal waters and this figure will be increased to 33% by 1980. The significance of this in the United Kingdom has of course been underlined by the work on North Seal Oil(43). The scale of this activity may be judged by the fact that the total capital expenditure on process industries is forecast to amount to £8,C billion pounds in the three years up to the end of 1977. Of this some 40% is likely to go on North Sea Oil production development (Ref.44)

Five years ago, efforts to interest Mr. Rivett and Mr. Clifton-Mogg in the possibility of using existing Lucas Aerospace valve technology, and the manufacturing facilities of the ballscrews to provide a complete valve operating and controlled system were ignored. It is perhaps not surprising therefore that Sir Fredrick Warner, Chairman of the N.E.D.C. process plant working committee maintains that process plant and equipment manufacturers are missing out to overseas companies on much of the North Sea Oil work. He stated in presenting the N.E.D.C. report on the 9th June 1975 'I wish we were getting half the business'. (Ref.45)

Although such valve work would represent only a minor part of the capital investment in such installations it would have been of major significance to Lucas Aerospace. However the real growth area would be in a whole range of automatic and electronically controlled remote equipment. 'It is easy to envisage a time when all facilities now used in processing and distributing oil are put in the sea bed in vast plants manned by men living in atmospheric conditions, or handled by robots and automatic systems electronically controlled from the shore' (Ref.46)

It is significant that Westinghouse and Lockheed are both actively engaged in these fields, and Lockheed are concentrating their efforts on developing sub sea working chambers which can be approached by diving bells (Ref. 47)

These activities will require a wide range of submersible vehicles which in turn will need generating and actuating systems on board. Lucas Aerospace should be entering into working agreements with the manufacturers of these in particular with Vickers Oceanics. In fact they should consider entering into an agreement with Vickers which would establish the same relationship which they have in the aerospace field with Hawker Siddeley or B.A.C.

Metal Bearing Nodules

One of the richest sources of mineral resources is the metal bearing nodules to be found on the sea bed. They exist virtually everywhere and are usually 20 to 40 mm in size and average 17% manganese and 11% iron. They also contain considerable quantities of trace elements of nickel, copper, cobalt and zinc, together with lead and phosphates. By the year 2000 the land sources of some of these metals will have been exhausted, whilst the marine reserves are enormous. The quantity of copper in nodule form for example is 150 times greater than the terrestial reserves (Ref. 48)

Although this field of activity is only in its infancy three large companies in the United States including Hughes Tool has already put 100 million dollars into the project to exploit the seas off California. In Europe both France and Germany have carried out initial experiments of deep sea retrievers. The initial investment of projects of this kind is likely to be enormous and as a consequence international co-operation is likely to be the pattern. In fact a spokesman for the German company said 'the technical development is so expensive that exploitation of these metal bearing nodules is out of the question for one firm alone, or even a national group of companies. It can only be done by international co-operation as through cross frontier consortia'.

Marine Agriculture

During the coming 10 years there is likely to be a growing interest in marine agriculture. Products of the sub acqua farms are likely to range from directly consumable vegetables to those producing by products which can be processed on land. This type of farming will require a whole range of special purpose small vehicles to take the 'farmers' down to the work areas. There are also likely to be requirements for a range of submersible vehicles and telechiric machines which could carry out both the sowing and reaping by remote control. It is our view that oceanics provides very important long term outlet for Lucas Aerospace as manufacturers of complete aircraft systems. We are in a unique position to provide total systems for the vehicles and equipment which will be required in this field. It would also be a logical point of entry for Lucas Aerospace into the wider and developing field of control systems as a whole. This is likely to be one of the leading growth areas during the coming years and a very considerable use of mini computers and micro-processers are likely to be involved. The predictions are that this will have a profound effect upon the whole nature of our technology during the coming years (Ref.7) This field would also provide a logical framework in which Lucas Aerospace could get involved in micro-processing systems. It is significant that some of Lucas's leading competitors such as Plessey are already making considerable advances in the micro-processer field.

BRAKING SYSTEMS.

The increased speed of both road and rail vehicles and the larger payloads which they will carry, both of passengers and goods, will give rise to stringent braking regulations during the coming years. This tendency will be further increased by Britains membership of the E.E.C. The E.E.C. is now introducing a range of new braking regulations. These specify, not only, stopping distances, but calls for minimum standards of braking endurance over a continuous period. In addition, the regulations lay down conditions for 'braking balance' between axles in order to prevent a dangerous sequence of wheel locking.

Many individual E.E.C. countries have, in addition, their own national braking requirements. In France for example, since the mid 50's auxiliary braking systems have been compulsory for coaches operating in mountainous terrain.

A fundamental weakness of normal mechanical brakes is that when subjected to long braking periods they overheat and the braking linings, at elevated temperatures, tend to temporarily lose their 'gripping qualtities'. This problem can be greatly reduced, if not totally overcome, by using a retarder. A Retarder is basically an electro magnetic dynamometer which is fitted usually to the prop shaft between the engine and the back axle. To reduce speed its coils are excited by an electrical supply direct for the vehicle battery, thereby inducing a braking force as the disc rotates in the magnetic field.

At the Willesden plant some 25 years design experience exists in this field of dynamometry. Attempts by the design staff some 10 years ago to get the Company to develop and simplify these eddycurrent dynamometers for mass production as retarders failed. It is felt, however, that the time is now opportune to reconsider this whole project.

In Britian public attention has been dramatically focused on the weaknesses of existing braking systems by the Yorkshire Coach disaster which claimed 32 lives in May of this year. The Sunday Times of June 1st stated 'last week's crash might have been avoided if the coach had been equipped with an extra braking device, such as an electro-magnetic retarder which is being fitted to an increasing number of coaches in this country" In fact it would appear that only 10% of Britians' 75 000 buses and coaches actually have retarders fitted to them. There is, therefore, clearly a vast market available to Lucas if it adopts an imaginative approach to this problem . It is not suggested that Lucas should simply produce dynamometers, rather what is proposed is that they should analyse the whole nature of braking systems

through a wide range of vehicles, including buses, coaches, articulated lorries, underground and overhead trains as used by British Rail.

It is proposed that a braking system analysis and development team should be set up to take an overview of this problem. The team should make an analysis of the actual requirements for the different applications, and at the same should analyse any patent problems which might arise with respect of the French Labinal retarder which is marketed in this country as 'Telma.' Simultaneously a development team should develop an existing Lucas Aerospace dynamometer, using a unit capable of being fitted in the conventional position, i.e. in the prop shaft between the engine and the back axle, capable of absorbing 600 brake horse power and the weight approx. 200 kgs. Once this unit has been designed and developed, discussions should take place with Girlings to arrange for its mass production under a licensing arrangement from Lucas Aerospace. Although a vast potential market exists for dynamometers of this kind this unit should be seen only as the first step in evolving a total braking system capability.

The second stage would be a combined electro magnetic braking system coupled directly to a traditional mechanical brake based on a Girling disc. The control system would have to be designed such that by moving the brake pedal the dynamometer would intially operate and the further depression of the pedal will gradually increase the current and hence the braking load until finally the mechanical brake could be applied if necessary. Use of the dynamometer between the prop shaft and the back axle clearly limits its range of application. To overcome this, discussion should take place with manufacturers of gear boxes to arrange to have them fitted on the output side of the gearbox such that they could be used on the tractors of articulated vehicles.

A further development would be to design and produce units which could be fitted to each individual axle. Work in this field is already being carried out in France, but based on traditional dynamometer units.

An elaborate control system would be necessary to ensure that as each of the individual axles is braked it still meets the new E.E.C. requirements concerning the sequence and the effects on individual axles and their proper synchronisation to remove the risk of unstable skidding or 'jack knifing'. This work would dove tail in conveniently with existing work being undertaken by Girlings on anti-skid systems. It is important that this programme should not be carried out in the usual piece meal short term manner. A long term overall plan should be worked out and each stage of the development programme should be a tactical step towards a long term strategy.

Part of that long term strategy should be the provision of radar applied braking systems. All the necessary components should be designed to produce a flexible range of system options. Dynamometers lend themselves ideally to this as the load is applied electrically. The 1975 Society of Automotive Engineers Congress held in Detroit, reported that the National Highway Safety Association's 71 statistics showed that 8% of the vehicles on the road were involved in rear end accidents. They represented 25% of accidents or 8½ million vehicles. The medium to long term aim should be to provide radar applied braking systems particularly for use on motor ways.

The Financial Times on May 7th 1975 stated "in the longer run electronic station keeping devices which use a form of radar to apply brakes automatically to cars travelling along motorways when they approach too close a slowly moving vehicle ahead may be adopted. If they were introduced compulsorily for traffic they would certainly lead to a substantial reduction in the number of lives lost through motorway accidents in fog".

R.A. Chandler and L.E. Woods of the U.S. Department of Commerce Institute for Telecommunication Sciences have said at the conference quoted above "while significant problems exist in the development of generally acceptable radar sensors for automobile braking, no insurmountable difficulties are evident". Applications more complex than mere station keeping should also be considered, but these give rise to a series of technological problems which, although they could be overcome, may only be soluble with very expensive equipment. However both Chandler and Woods had the following to say "both pedestrians and the cyclists are detectable, radiation hazards are minimal, small radius corners give a problem in false alarms, inter-system blinding is a problem and that the effect of rain scattering are serious". Spokesmen for the National Highway Traffic Safety Association have stated that research in radar braking fields warrants continuation, but the decision to implement such devices should be made only after cost benefit studies and acceptable hardware performance had been verified. It is clear that now is the stage for Lucas to become involved in these developments.

It is proposed that a similar long term overview should be taken of braking requirements for rolling stock railways and undergound. Already British Rail has introduced, on an experimental basis, velocity monitoring systems, which indicate to the driver if he is travelling at a velocity considered to be dangerous for an oncoming curve, junction or other impediment. With these velocity sensing devices already installed, it would be a logical step to use this information to feed into braking systems such that the train was automatically slowed down to meet the travelling requirements already determined for other sections of the track if the driver fails to respond due to illness or whatever. Such overall braking systems would require many computers and micro processors. The use of these would fit in with suggestions made elsewhere in the Corporate Plan.

TRANSPORT SYSTEMS

Road Vehicles.

There will be an increasing requirement for battery powered vehicles during the next 20 years. However the numbers involved are not likely to be substantial until alternative forms of battery power storage and battery production have been developed, and until means of charging these, other than using conventionally produced electricity have been developed.

In the meantime there is likely to be a growing interest in hybrid systems which make the best use of battery storage and couple that with the optimum performance of internal combustion engines. It is therefore proposed that a hybrid system be evolved utilising the I.C. engine running at a permanent and optimum power setting and connected to a generator. The generator would charge the batteries which in turn supply the power to the electric motor driving the vehicle. Viewed in the wider company context it may be desirable to use the diesel engine with its inherent advantages of better fuel consumption characteristics. Initial calculations suggest a 50% fuel saving in such a hybrid.

The Ground Support Equipment Group of the Aerospace division already has considerable experience in the packaging of coupled prime movers and generators. In addition it has developed considerable expertise in the silencing of units of this kind without greatly impairing the efficiency of the engine. This would mean, not only could atmospheric pollution be greatly reduced, in that the toxic emissions would be reduced by some 70 to 80% by the permanent power setting, but the noise pollution could be greatly reduced as an added advantage.

The existing Lucas battery powered vehicles could be used as a test bed for this generator package. It is therefore proposed that designers from the Ground Support Equipment Group liaise with their colleagues in the Lucas Electrical Co. and C.A.V. so that a specification can be drawn up for the 'hybrid package'.

A prototype should then be built by the Ground Support Equipment Group and tests carried out in the vehicles already in existence.

Air Transport

In Western Europe the pressure of urbanisation and the density of population will mean that transport systems, other than rail and road, will increasingly be sought. There is a growing and understandable public hostility to conventional air traffic systems with the problems of air and noise pollution in the immediate vicinities of airports. These considerations and ones of economy are likely to give rise to a growing interest in airships. Explosion hazards associated with hydrogen are likely to continue to make that an unsuitable lifting source, helium is extremely expensive. Docking, loading and unloading problems are considerable. To release a load of 250 tons would require a release of nearly 9 million cubic feet of helium and cost something in the order of £100 000.

In addition there is growing concern as to the availability of helium in the future. The present rate of consumption of the resources of crude helium can only be expected to last for a few more decades. In these circumstances a system such as 'Air-float' is highly desirable. However to allow for fine control over its load/unload position, complex vertical and horizontal vectoring power units will be required.

It is suggested that Lucas could make a major contribution in this. It is proposed that direct contact should be made with Dr. Edwin Mowforth of the University of Surrey in order that Lucas's contribution to this development could be explored in detail.

The Combine has already been in contact with Dr. Mowforth on this issue.

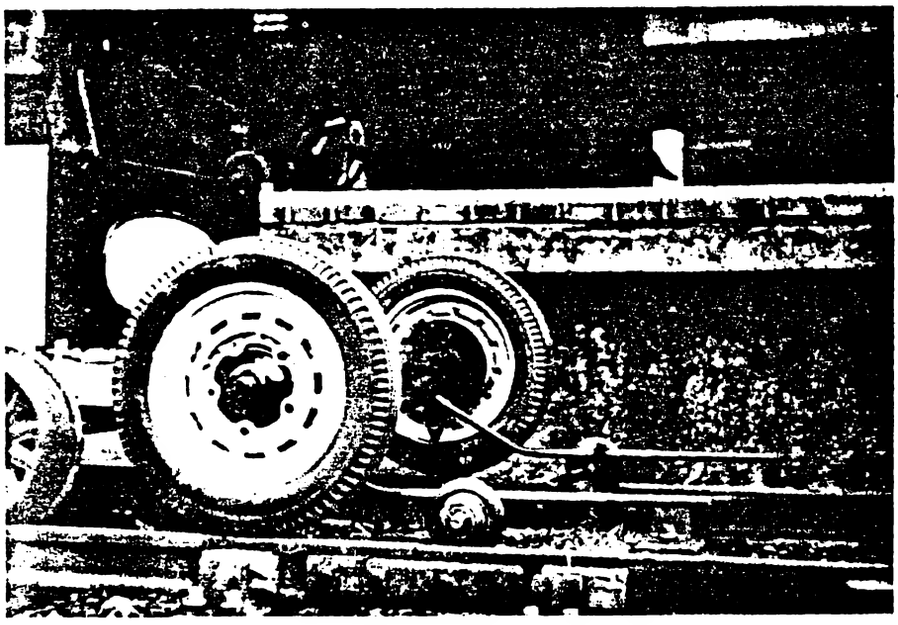
Railway Systems

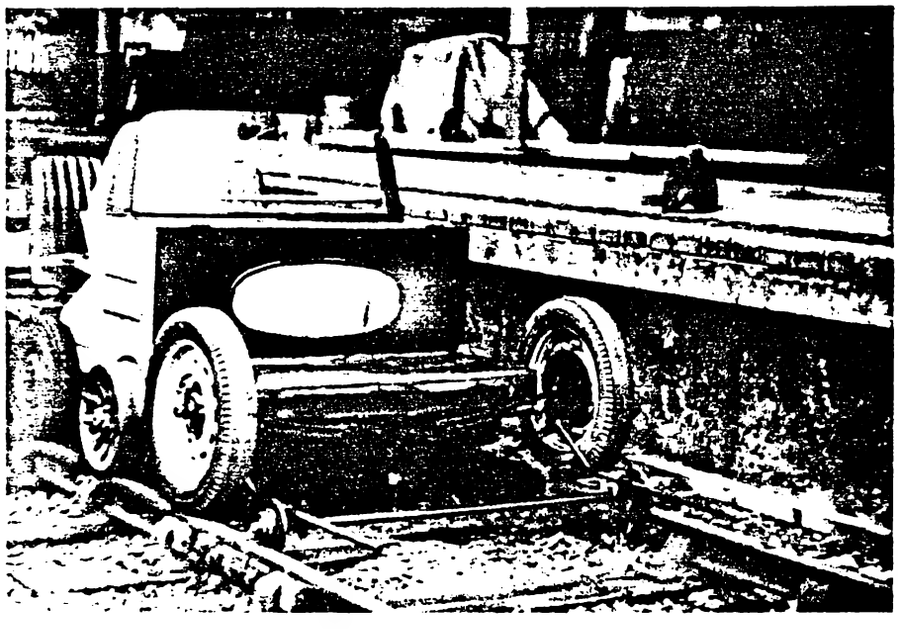
The structure of railway coaches is based on a design philosophy which is about 100 years out of date. Strength and weight of railway coach structures depends essentially on the characteristics of rigid wheel on the track and its power transmissions through that. R. Fletcher of the North East London Polytechnic pointed out for a number of years that these problems could be overcome if pneumatic wheels were used. The entire suspension system of the vehicle could then be much lighter as could the overall payload bearing structure. This work is currently supported by a Science Research Council grant. If Lucas were to accept the proposal for braking systems made elsewhere in this Corporate Plan they could extend that idea by providing a complete wheel and axle unit which would embody a pneumatic wheel, a retarder and disc brake. Aerospace would provide the automatic braking system and the micro-processors to operate the unit.

With the overcrowding on roads such a light weight train could be used to great advantage on suburban lines and might even be used on some of the lines now closed by the Beeching Plan. It is therefore proposed that contact should be made with R. Fletcher to establish in which way the braking systems could be incorporated into an overall design philosophy for these lightweight railway vehicles.

Approximately 10 years ago Lucas Aerospace spent vast sums of money on developing a railway actuator. Basically the idea was that a vehicle could be taken directly from a railway and run on wheels suitable for conventional road surfaces. These wheels to be actuated into position by a system provided by the then Rotax Division. It is suggested that the system should now be re-examined in light of current transport requirements. It should be particularly re-examined in light of the proposals above for a light weight vehicle.

The (Scottish) Highland and Islands Development Board has already shown considerable interest in such a hybrid road/rail system. A section of track has been located where the tests can be carried out. The hybrid prime mover proposed above (Page 24) and the 'Braking System (Page 21) should be incorporated into the final design.





Pneumatic tyred road/rail transport proposed in the Lucas corporate plan. On the test vehicle flanged wheels provide guidance, but the vehicle is steered by tread forces.

3 month period expand the team to cater for the following work:

a. The design of a 600 brake horse power unit weighing approximately 200 kgs.

b. An integrated braking system incorporating both mechanical disc brakes and dynamometers.

c. Anti-skid systems.

d. Automatic braking systems incorporating station keeping capabilities.

e. Complete braking systems for railways.

4. Transport Systems.

a. The design and development of a prototype hybrid power package incorporating internal combustion engine generator, batteries electric motor.

b. Airship vectoring systems.
Arrange meetings with Dr. Edward Mowforth of the University of Surrey.

c. Combined road/rail vehicle. Establish transport systems design and development team.
Establish working relationship with R. Fletcher of the North East London Polytechnic whose work in this area is supported by the Science Research Council.
Examine feasibility of providing integrated braking system for this vehicle together with micro-processors, suspension systems using Girling know how and the hybrid power package outlined above.
Contact Scottish Development Board, and Derbyshire County Council through R. Fletcher with a view to establishing a test section of existing track.
Re-examine the Rotax railway van actuator in light of current requirements.

5. Oceanics

Establish working relationship with Vickers Oceanics.
Consider feasibility of providing complete systems for submersibles.
Examine the feasibility of designing, developing and manufacturing, either independently or with Vickers, telechei ric devices for metal bearing nodule collection and marine agriculture.

6. Micro-processors

Marston Green Electronic Group to consider the provision of micro-processors for the systems outlined above.
Particular attention to be paid to the development at Plessey's.

7. Medical

Establish a medical division at G & E Bradleys, initially increasing the production of kidney machines there by approximately 40%.
In conjunction with Ministry of Health build up a 'design for the disabled' unit.
Investigate the feasibility of applying aerospace technology to provide 'sight' to the blind.

8. Power Units

Examine the requirements of the computer industry for standby power units using automatic sensing and starting systems, to be develop.ed by Marston Green.
Carry out market survey of requirements of Middle East Oil producing countries and newly emergent nations for power packs built on a module basis to meet alternatively the requirement for pumping facilities, hydraulic power pack facilities, electricity generation and compressed air.

9. Industrial Ball Screws

See attached appendix and analyse the application of ballscrews to valve control systems, machine tool control systems, telecheiric machines and submersible vehicles.

10. Telecheiric Machines

Augment existing systems and actuator know how with specialists in remote control field.
Examine application for fire fighting telecheiric devices, mining machines and underwater devices.

11. Employee Development Programme

Arrange Union/Management negotiations on employee retraining.
In the event of immediate redundancies negotiate full time education as a form of work sharing backed by government grants.
Unions to have discussions with the Department of Employment and Manpower Services commission.

12. Integrated Product Teams

Union/Management negotiations on the establishment of integrated product teams' incorporating design, development production engineering and manufacturing in one group.
Negotiations on the redesign of jobs.
Union to meet Dr. Gilbert Jessop of the Work Research Unit of the Department of Employment to discuss job satisfaction schemes.

13. Other Products Under Consideration for Enlarged Corporate Plan

a. Linear motors operating pumps and compressors.
b. Range of applications for the '60 and 90 Gas Turbine'
c. Robot helicopter using Lucas gas turbine for crop spraying.
d. High speed motors.

Principal Subsidiary Companies

The following list excludes subsidiary companies which do not materially affect the Accounts.
All companies are wholly owned subsidiaries except where otherwise stated.
Interests in companies marked * are held by intermediate subsidiaries.
The trading of companies marked † is incorporated in the accounts of Lucas Trading Ltd.

United Kingdom
(Registered in England)

Management Companies:

Joseph Lucas Ltd.

Lucas Trading Ltd.

Vehicle Equipment Companies:

The Lucas Electrical Company Ltd.†
Joseph Lucas (Sales & Service) Ltd.†
Lucas Service Overseas Ltd.†
Lucas Batteries Ltd.†
C.A.V. Ltd.*†
Girling Ltd.*†
Rist's Wires & Cables Ltd.*
Butlers Ltd.*
Globe & Simpson Ltd.*
Cox (Electrodiesel) Ltd.*
Crosland Filters Ltd.*

Aircraft Equipment Company:

Lucas Aerospace Ltd.*

Industrial Equipment Companies:

G. & E. Bradley Ltd.
Bryce Berger Ltd.*
Leslie Hartridge Ltd.
Lucas Defence Systems Ltd.†
Lucas Marine Ltd.
Simms Motor & Electronics Corp. Ltd.
Clearex Plastics Ltd.*
Dawe Instruments Ltd.*
Keelavite Hydraulics Ltd. (24·5% of Preference Share Capital owned outside Group)
Lucas Industrial Equipment Ltd.†
N.S.F. Ltd.*
N.S.F. Controls Ltd.*
A. R. Parsons Ltd *
Semicomps Ltd.*

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N.S.F. Ltd.*
N.S.F. Controls Ltd.*
A. R. Parsons Ltd *
Semicomps Ltd.*

Principal Subsidiary Companies — continued

Europe

France

Freins Girling S.A.*
Societe Francaise des Industries Lucas S.A.*
Lucas France S.A.*
Lucas Service Europe S.A.R.L.*
Sasic S.A. (68%)*
Societe Roto-Diesel S.A.
Messier Auto Industrie S.A.R.L. (51%)*

Germany

Joseph Lucas (Germany) G.m.b.H.*
Girling Bremsen G.m.b.H.*

Italy

Lucas Carello S.p.A.

Spain

Lucas (Iberica) S.A.

Sweden

Agebe Ab.*

Switzerland

Lucas International Company S.A.
Joseph Lucas (Switzerland) A.G.*
Lucas International Trading S.A.

Overseas

Australia

Joseph Lucas (Australia) Pty. Ltd.

New Zealand

Joseph Lucas (New Zealand) Ltd.

Canada

Joseph Lucas Canada Ltd.

U.S.A.

Joseph Lucas North America Inc.

India

Lucas-T.V.S. Ltd. (60%)
Lucas Indian Service Ltd. (60%)*

Japan

Nihon-C.A.V. Ltd. (98%)*
Nihon Lucas (Sales & Service) Co. Ltd. (99%)

Pakistan

Lucas Service (Pakistan) Ltd.

Argentina

Martin Amato y Cia S.A.I.C. (80%)*
Lucas Service Argentina S.A.C.I.F.I. y E. (80%)

Brazil

Lucas do Brasil S.A. Ind. E. Com.
Souza Duarte S.A.*
Acumuladores Vulcania S.A. (55%)

Mexico

Electro Diesel de Mexico S.A. (96%)*
Inyec Diesel S.A. de C.V. (63%)*

Panama

Lucas (America Latina) S.A.

South Africa

Lucas Industries South Africa (Pty.) Ltd.
Joseph Lucas (Pty.) Ltd.*
Lucas Service (Pty.) Ltd.*

Rhodesia

Joseph Lucas C.A. (Private) Ltd.

Principal Associated Companies

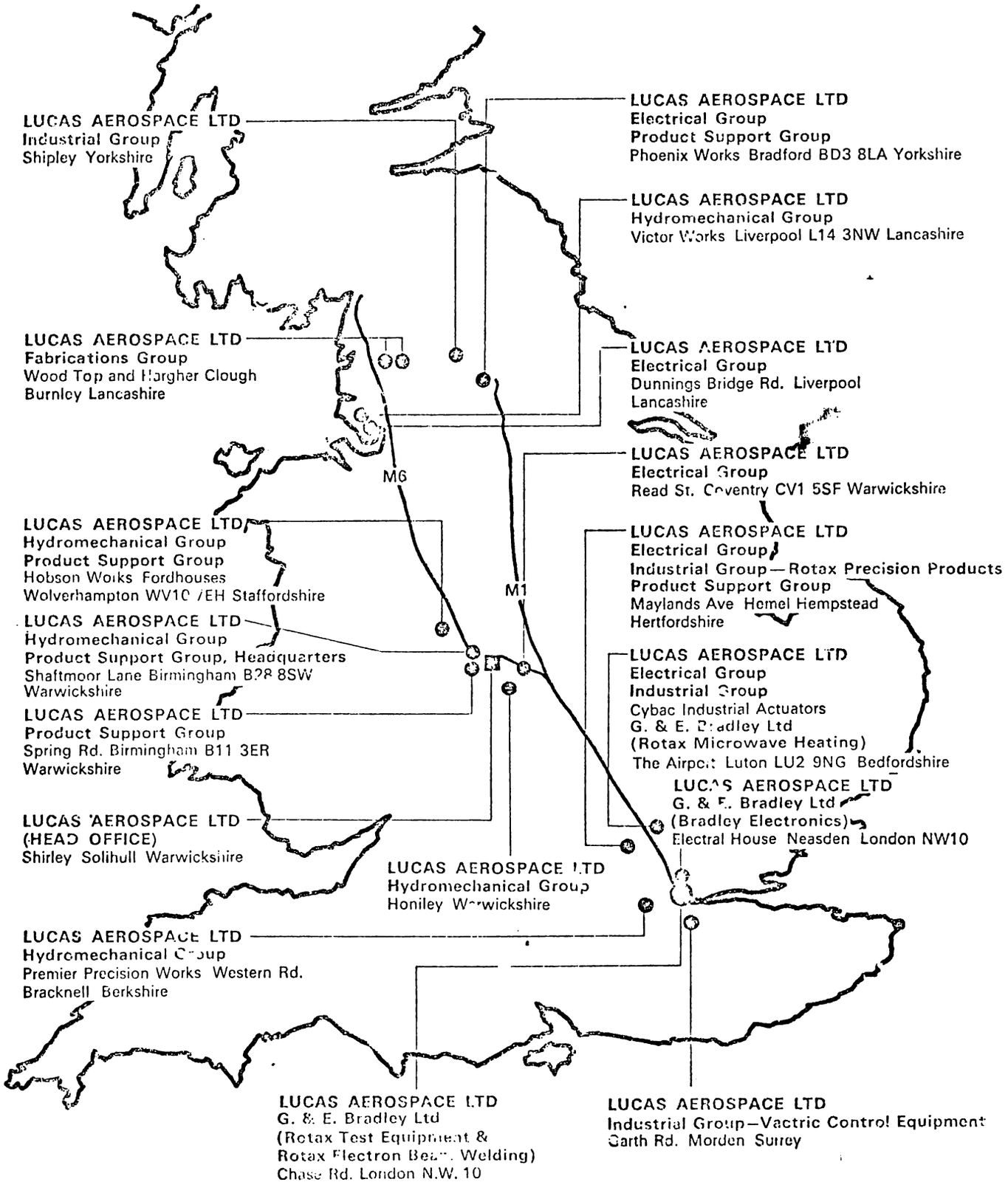
The following list excludes associated companies which do not materially affect the Accounts. It shows the dates to which the accounts incorporated in the Consolidated Profit and Loss Account were prepared.

Interests in companies marked * are held by intermediate subsidiaries.

	Class of Capital and Percentage held	Accounting date
United Kingdom *(Registered in England)*		
British Batteries Overseas Ltd.	Ordinary 50	31.3.75
British Sealed Beams Ltd.	Ordinary 40	31.5.75
Centralab Ltd.	Ordinary 50*	31.7.75
Europe		
France		
Ducellier et Cie	Partnership 40*	31.8.74
Thomson-Lucas S.A.	Ordinary 49*	30.6.75
Germany		
Pierburg Luftfahrtgerate Union G.m.b.H.	Ordinary 34*	31.12.74
Italy		
Fausto Carello & C. S.p.A.	Ordinary 40	31.12.74
Lucas Filtri S.p.A.	Ordinary 40	31.12.74
Spain		
Condiesel S.A.	Ordinary 47*	31.12.74
Overseas		
Australia		
Automotive & Girling (Pty.) Ltd.	Ordinary 50	31.12.74
Brazil		
Maquinas Varga S.A.	Ordinary 30 Preference 30	31.12.74
India		
Brakes India Ltd.	Ordinary 49	31.12.74
Iran		
Lucas Tundar	Ordinary 35	22.7.75
South Africa		
Automotive & Girling (S.A.) (Pty.) Ltd.	Ordinary 50*	31.7.75
U.S.A.		
Hyperloop Inc.	Ordinary 40*	31.3.75

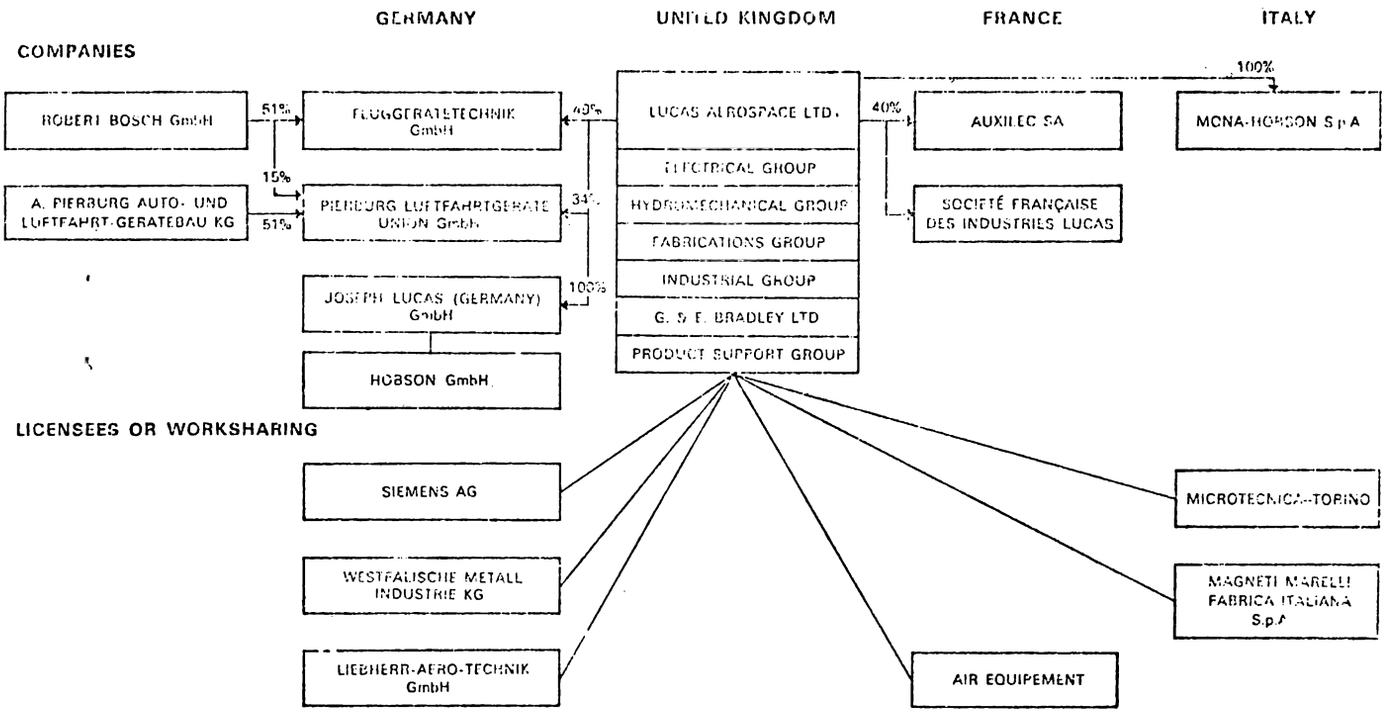
LUCAS AEROSPACE LTD

Locations of Factories



Overseas Companies and Licensees

Lucas Aerospace in Europe



Lucas Aerospace in Australia and North America

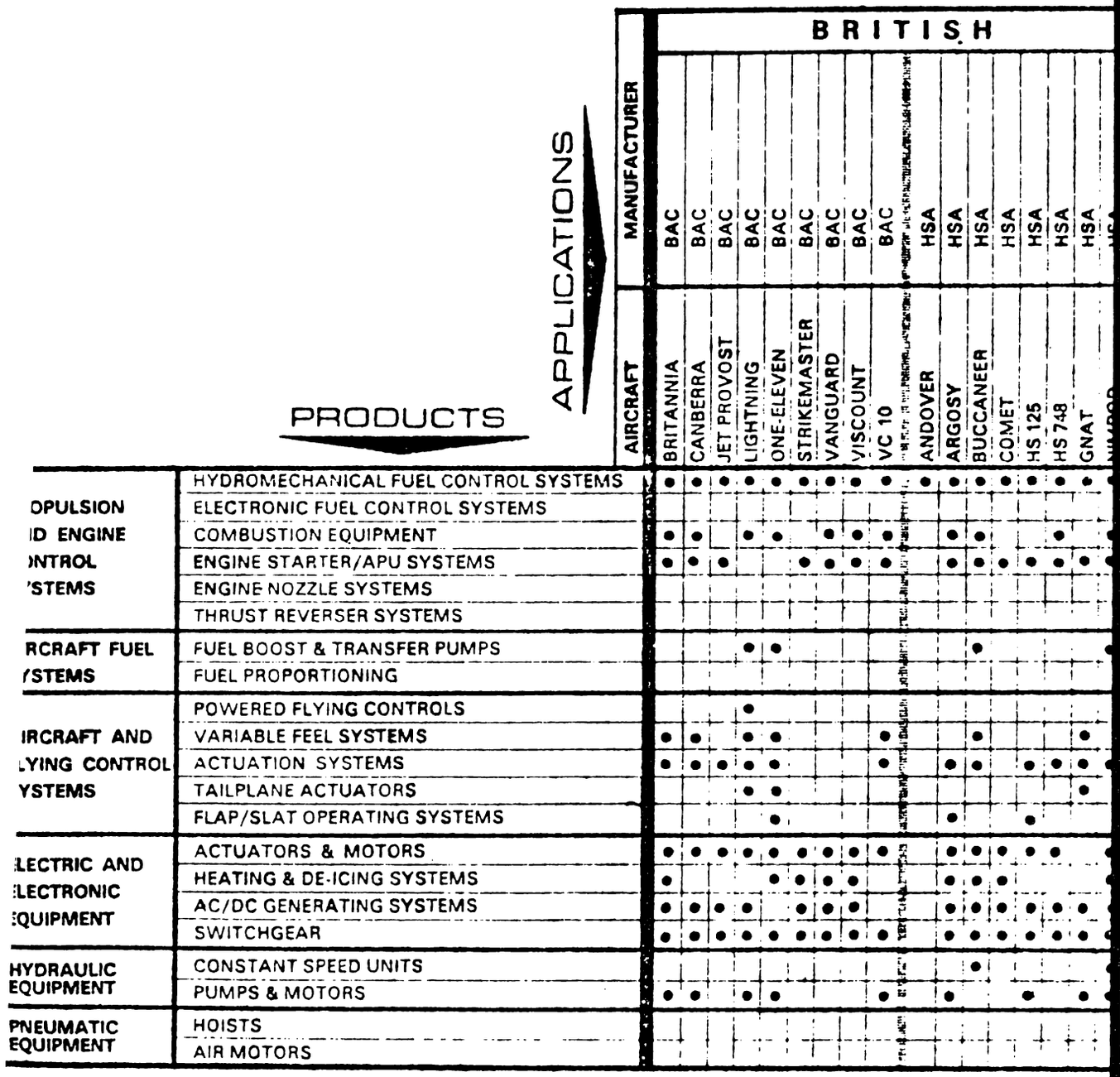
Lucas-Rotax (Australia) Pty. Ltd
Joseph Lucas North America Inc.
Lucas-Rotax Ltd., Canada

Lucas Aerospace Licensees in

Australia
Canada
France
W. Germany
India
Italy
Japan
Sweden
U.S.A.

JCAS AEROSPACE

RCRAFT and GAS TURBINE
ONTROL SYSTEMS –
QUIPMENT



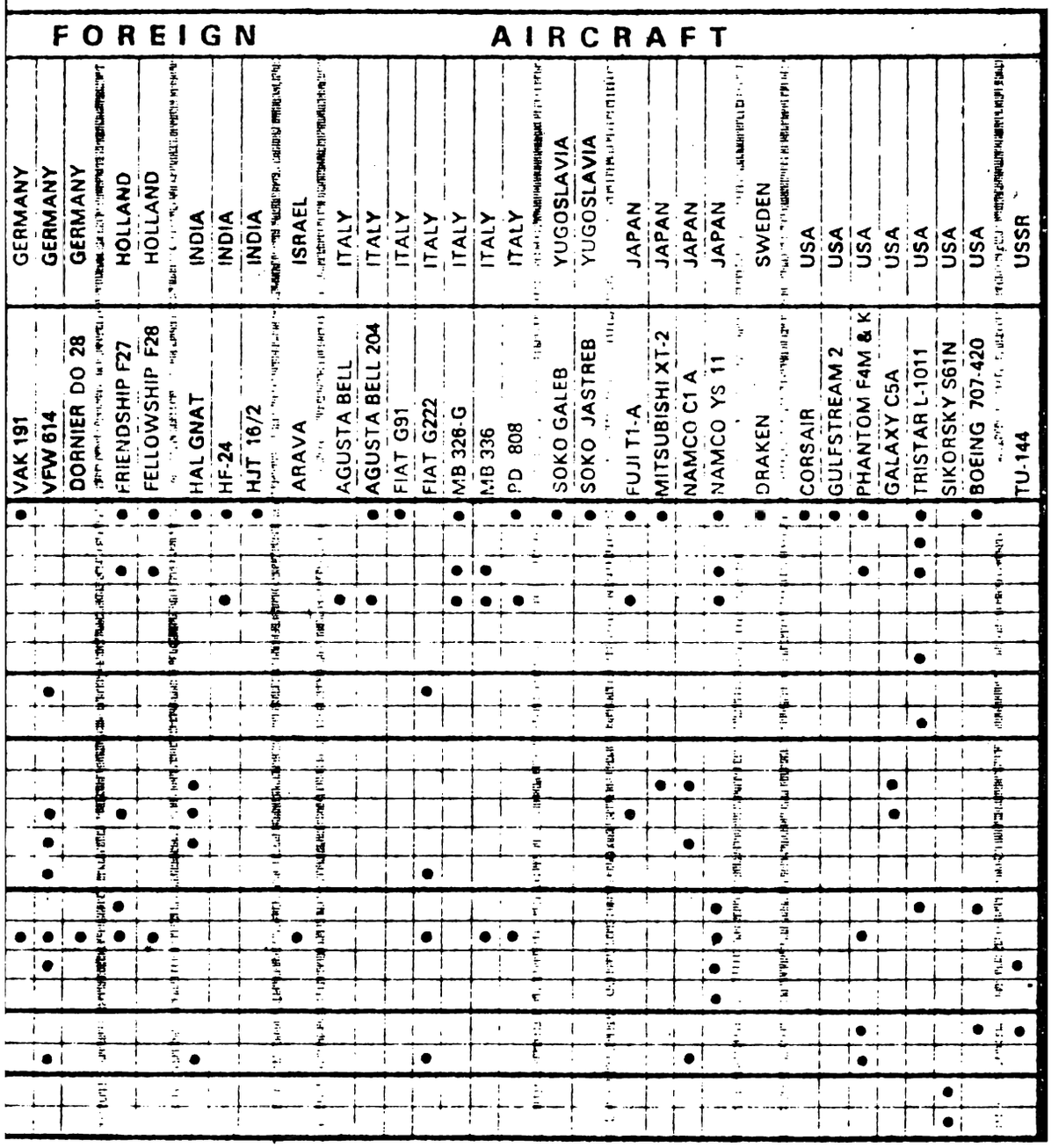
LIMITED

AIRCRAFT	
HUNTER	HSA
SCIMITAR	HSA
SHACKLETON	HSA
TRIDENT	HSA
VICTOR	HSA
VIXEN (SEA)	HSA
VULCAN	HSA
BELFAST	SHORT
SKYVAN	SHORT
SCOUT	WESTLAND
SEA KING	WESTLAND
WASP	WESTLAND
WESSEX	WESTLAND
WHIRLWIND	WESTLAND
HERALD	

INTERNATIONAL	
ALPHA JET	BREGUET/DORNIER
A300 B	AIRBUS INDUSTRIE
CONCORDE	BAC/AEROSPATIALE
JAGUAR	BAC/BREGUET
MRCA	PANAVIA
TRANSALL	TRANSALL
SA 341 GAZELLE	WESTLAND/SUD
WG 13 LYNX	WESTLAND/SUD

AIRCRAFT	COUNTRY
JINDIVIK DRONE	AUSTRALIA
CANADAIR CL-44	CANADA
ATLANTIC	FRANCE
CARAVELLE	FRANCE
MIRAGE F 1	FRANCE
MIRAGE 3 & 4	FRANCE
DORNIER DO 31	GERMANY

Member of JOSEPH LUCAS (INDUSTRIES) LTD.



Product Range

ENGINE SYSTEMS

Fuel Control Systems
Fuel Pumps
Combustion Equipment
Thrust Reverser Actuating Systems
Nozzle Actuating Systems
Engine Starters
Engine Intake Control Systems
Starter/Auxiliary Power Units
Engine Intake Anti-icing Systems
Ignition Systems and Components
Sprayers
Harness Wiring
Starting Jets
Bellows

GENERATING SYSTEMS AND ASSOCIATED CONTROL GEAR

AC & DC Generators
Constant Speed Drives
Starter Generators
Control Equipment
Regulators
Switchgear and Circuit Breakers
Transformer Rectifier Units
Rotary Inverters
Static Inverters
Variable Speed Drives
Linear Actuators
Rotary Actuators
AC & DC Motors
Stepper Motors
Geared Motor Units
Heating Systems and Equipment
Ice Detectors
Lighting
Blowers

FLIGHT CONTROL SYSTEMS

Powered Flying Controls
Flap Operating Systems
Slat Operating Systems
Wing Sweep Operating Systems
Variable Feel Systems
Auto-pilot Actuators
Tail Plane Actuators
Actuators

HYDRAULIC POWER SYSTEMS

Hydraulic Pumps
Motor Pump Power Packs
Power Transfer Units
Hydraulic Motors
Hydraulic Hoists
Quick Release Couplings
Constant Speed Drives

AIRCRAFT ENGINE FUEL SYSTEMS

Fuel Boost and Transfer Pumps
Fuel Flow Proportioners
Fuel Flow Metering
Quick Release Couplings

PNEUMATIC EQUIPMENT

Engine Starters
Nozzle Drive Units
Thrust Reverser Drive Units
Valves
Air Hoists

MECHANICAL EQUIPMENT

Gearboxes
Ballscrews
Flexible Drives
Transmissions

ELECTRONIC EQUIPMENT

Microwave Heating Systems
Microwave sub-systems for Radar and Communications
Digital Voltmeters
Counters and Timers
Pulse Generators
Oscilloscopes
Calibrators

MEDICAL EQUIPMENT

Haemodialysis Systems
Cardiac Pacemakers
Arterial Blood Pressure Monitor
Muscle Stimulation Equipment
Aversion Therapy Equipment

INSTRUMENTATION

Voltage Indicators
Speed Probes
Signal Convertors
Servo Motors
Transducers
Sierraglo Instrument Panel Lighting
Tacho-generators
Earth Fault Detectors
Encoders

AIRFRAME AND ENGINE FABRICATION

Wing De-icing
Logic Sequencing and Protection Thermal Control Units
Sierracote Windows
Combustion Equipment

TEST AND SERVICE

Icing Wind Tunnel
Systems and Equipment Test Gear
Air Data Test Equipment
Portable Generator Sets
Dynamometers
Ground Power Supplies
Communications Test Equipment
Test Rigs
Test Consoles
BCS Approved Electronic Standards Laboratory
Radio Interference Laboratory
Environmental Test
Electron Beam Welding

MACHINE TOOL EQUIPMENT

Electric Servo Drive Systems
Digital Readout Systems
Stepper Drive Systems

Test Facilities

APPENDIX 7

PRODUCT LABORATORIES

- Complete Systems
- Hydraulics
- Electrical Machines
- Control Gear
- Actuators
- Ignition
- Electronics
- Medical Equipment

ENVIRONMENTAL LABORATORIES

- High Altitude
- Sea Level
- Climatic
- Vibration
- Acceleration
- Explosion Proofing
- Sand and Dust
- Salt Spray
- Fire Resistance
- Fungus Growth and Tropical Test
- Endurance
- De-icing
- Rain Erosion

INVESTIGATIONS LABORATORIES

- Metallurgical
- Radio Interference
- Chemical
- Metrology
- Radiographic
- Stress Analysis
- Non-metallic
- Flow Visualisation
- Acoustics
- High Speed Photography

CONSTITUTION OF THE LUCAS AEROSPACE AND DEFENCE SYSTEMS

COMBINE SHOP STEWARDS COMMITTEE

TITLE

1. The Combine Committee shall be known as THE LUCAS AEROSPACE AND DEFENCE SYSTEMS COMBINE SHOP STEWARDS COMMITTEE.

COMPOSITION

2. The Committee shall be comprised of representatives elected by the Shop Stewards Committee at each Plant within the Lucas Aerospace Division.

OBJECTIVES

3. The objectives of the Combine Committee shall be in the first instance, to support, co-ordinate and initiate such steps as may be necessary to improve the job security, wages and conditions of all Lucas Aerospace employees.

4. Further, it shall support the efforts of those elsewhere in the Lucas Organisation and in its subsidiaries and associate companies abroad to establish parallel Combine Committees and to improve their job security, wages and conditions.

5. It shall work for vigourous democratic Trade Unionism, free from State or Employer interference, and 100% Trade Union Organisation at each Plant.

6. Recognising the Community of Interest of all working people everywhere, it shall support their efforts to improve wages and conditions.

FREQUENCY OF MEETINGS

7. In order that the objectives set out above (3 to 6 incl.) can be energetically campaigned for, the Combine Committee shall meet at least three times annually to determine overall strategic policies. At these meetings the representatives shall reflect the views of their respective Shop Stewards Committee. The minutes of these meetings to be circulated at the earliest opportunity.

RECOMMENDATIONS

8. The individual site representatives shall then recommend the Combine policies to each Shop Stewards Committee and shall campaign for their acceptance. The outcome of the Shop Stewards Committee's deliberations shall be conveyed, in writing, to the Combine Committee Secretary within 14 days.

COMBINE EXECUTIVE

9. In order that the policies of the Combine Committee can be properly progressed between meetings a Combine Executive shall be elected at the first meeting each year (the A.G.M.). It shall carry out the policies of the Combine Committee and report to and receive instructions from each Combine meeting.

10. The Combine Executive shall include the Combine Committee Chairman, Vice Chairman, Secretary, Liaison Officer, Treasurer and such other persons as the Combine Committee may deem suitable to serve on it to a maximum of eight Executive members in total.

EMERGENCY COMBINE MEETINGS

11. An emergency meeting of the Combine Committee may be called by the Combine Executive or upon the request of a simple majority of the voting members (see 19 below) or upon the request of any Site in dispute.

FINANCES

12. The Combine Committee shall be financed by an affiliation fee of 10np per member per annum. This may be directly from Shop Stewards funds or by way of a special levy.

13. The Treasurer shall be responsible for the funds and shall report on Income and Expenditure to each Combine meeting.

14. Cheques shall be signed by the Treasurer and either of two Trustees appointed by the Combine Committee.

15. Cheques for payments for approved purposes up to £10 may be authorised by the Treasurer. Those over £10 must be authorised by at least 2/3rd of the Combine Executive.

16. Executive members may claim expenses from the Combine Funds for attendance at Combine meetings or when acting on behalf of the Combine Committee. Details of the payment of such expenses must be included by the Treasurer in his report on Income and Expenditure to each Combine meeting. An audited statement of accounts to be available at the A.G.M.

COMBINE NEWS

17. It is recognised that the success of the Combine Committee will depend upon the mass involvement of a well informed membership at each Site. To this end the Executive shall publish, on behalf of the Combine Committee, a newspaper which shall be called "COMBINE NEWS". This paper shall be published on a regular basis and shall campaign for Combine policies. No views other than these policies shall appear except as signed articles or letters from individuals or Shop Stewards Committees.

PRESS STATEMENTS

18. No Press or Publicity Statements shall be made on behalf of the Combine Committee except by the Secretary or those whom the Secretary authorises to do so on his behalf. All Press and Publicity Statements shall be in accord with the policies of the Combine Committee.

VOTING

19. Each Shop Stewards Committee may send as many representatives as they wish to each Combine meeting provided always that they meet their expenses. Voting shall however be limited to 1 vote per Site taken on a geographical group basis namely, Bath, Birmingham, Bracknell, Bradford, Burnley, Coventry, Hemel Hempstead, Liverpool, Luton, Neasden, Netherton, Willesden, Wolverhampton.

COMBINE OFFICIALS

20. The officials of the Combine shall be the Chairman, Vice-Chairman, Secretary Treasurer, Liaison Officer and 2 Trustees. They shall be elected at the first meeting each year (the A.G.M.) for a duration of 1 calendar year with the exception of the Chairman OR Secretary, who, for the purpose of continuity. shall serve for a duration of 2 years. Each official shall be eligible to stand for re-election.

ALTERATIONS TO THE CONSTITUTION

21. It is recognised that as the work of the Combine Committee grows and develops its Constitutional requirements may change in the light of actual experience. To facilitate such changes the Combine Committee, at its A.G.M., may alter the whole of the Constitution or the parts thereof provided that 2/3rds of the voting members (see 19 above) approve such alterations. Prior notice of proposed alterations must be circulated by the Secretary to each Site two weeks in advance of the A.G.M.

QUORUM

22. All those entitled to attend Combine and Executive meetings shall be given proper notice of such meetings. Seven of the thirteen voting members of the Combine Committee as defined in 19 above shall constitute a quorum of that Committee.

Five of the eight Executive members shall constitute a quorum of the Executive Committee.

MAJORITY DECISIONS

23. Majority decisions shall be binding and membership of the Combine Committee shall be conditional upon the acceptance of such majority decisions subject to the provisions of 8 above.

SOCIAL RESPONSIBILITY AUDIT: A CHECKLIST

External environment:

Social responsibilities and new opportunities
Community relations
Consumer relations
Pollution
Packaging
Investment relations
Shareholder relations

Internal environment:

Physical environment
Working conditions
Minority groups
Organisation structure and management style
Communications
Industrial relations
Education and training

'The ENGINEER'

8 February 1973

Social auditing at Singer (France)

	Score from 0 to 20		
	1972	1973	1974
Economic role			
Profit (1)	12.20	13.14	13.10
Product utility	—	12.97	13.95
Product quality	—	—	15.79
Employee satisfaction			
Work conditions	11.50	14.44	14.66
Communication and information	12.80	13.16	13.89
Job security	10.10	12.22	12.80
Salaries	11.20	12.46	12.64
Corporate morale	13.00	13.27	15.02
Training	—	14.65	14.45
Social role			
Community service (2)	12.70	14.16	14.85
Environmental improvement	11.40	13.72	15.16
Customer satisfaction	11.60	13.07	13.70
Receptiveness to change			
New products	11.00	13.13	13.57
Receptiveness to new ideas/ innovation (3)	—	12.79	13.23
Average score	**11.70**	**13.30**	**14.05**

Notes 1-3; following questions were posed: (1) Is profit high enough to ensure future growth? (2) Are the company's products useful to society; do they promote its wellbeing? (3) Does the company implement new ideas?

'VISION'

February 1975

Corporate Plan. - Questionnaire

Factory (a) 1. Size - - - Sq. ft. of Floor Space
11. Other space e.g. Car Parks, Perimeters, Land etc.
111. Total space.

(b) 1. Age and condition of buildings
11. Suitability of buildings for modern means of production.

(c) 1. Location and access e.g. Near motorway, main road or railway link.
11. Other services e.g. Telex, computer, Gas etc.

(d) Current value of site and buildings

(e) Provide site plans.

Workforce (a) Total No. Employed

(b) 1. Total No. Hourly Paid
11. No. Skilled
111. No. Semi - Skilled
1V. No. Unskilled

(c) 1. Total No. Staff
11. No. of Design, Development etc.
111. No. of other technical staff e.g. Production Engineering, Contracts, Technical Sales etc.
1V. No. Administrative Staff
V. No. Supervisory Staff

(d) 1. General availability of labour
11. Availability of skilled labour
111. Availability of design and other technical staff

(e) Special skills

(f) Age spread in each group

(g) 1. Total Payroll
11. Staff
111. Works

(h) Training and apprentices

Equipment (a) 1. Total No. of Machine Tools
11. Breakdown into groups e.g. Lathes, Mills, N.C. Machines etc.

(b) Other production facilites e.g. Heat Treatment, Plating, Welding etc.

(c) Details of equipment e.g. Age, Value, Condition etc.

Products (a) 1. List present product range
11. List subcontract work Out and No. of hours
111. List subcontract work In and No. of hours
1V. Hourly rate for manufacture

(b) List products made in past

(c) 1. List new products under development
11. Any other new products outside aircraft work which your plant could design, develop and manufacture
111. Any socially useful products which your plant could design develop and manufacture
1V. Any subcontract work on which the skill of your members could be used
V. Any joint projects with other companies or government bodies.

Running the Plant

(a) 1. How could the plant be run by the workforce itself?
11. Could existing 'line' managers still be used?
111. Have you got a joint staff and works Shop Stewards Committee.?
1V. Have you set up a local Corporate Planning Committee.?

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